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Do Private Commercial Banks Outperform State-owned Commercial Banks? Empirical Evidence from Bangladesh

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Abstract

The paper seeks to measure and compare the performance of state-owned commercial banks, conventional private commercial banks and Islamic commercial banks operating in Bangladesh during 2009-2014 using the Data Envelopment Analysis (DEA). It uses a sample of 19 commercial banks comprising four state-owned banks, ten conventional private commercial banks and five Islamic commercial banks. The paper shows that the average technical efficiency scores of state-owned banks, conventional private banks and Islamic banks are 0.8592, 0.9419 and 0.9569 respectively. This means that state-owned banks experience highest inefficiency of 14.08% followed by conventional private commercial banks (5.81%) and Islamic banks (4.42%). It is also found that state-owned banks and Islamic banks face technical inefficiency due mainly to scale inefficiency while technical inefficiency of conventional private commercial banks is attributed mainly to pure technical inefficiency. The efficiency results suggest that state-owned commercial banks and Islamic banks need to improve their technical by enhancing scale efficiency. Conventional private banks may improve their technical efficiency by upgrading managerial performance.

JEL Classifications Numbers: C14, C61, G21
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1 Introduction

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The well-performing commercial banks can allocate financial resources efficiently among competing economic agents in an economy by promoting savings and investments process aiming at higher growth and poverty alleviation. The association between an efficient financial system and the benefits to the real economy is now well-established in a growing number of empirical studies (King and Levine 1993 [1]; Beck and Demirgue-Kunt 2004[2]; Demirgüc-Kunt et al 2008 [3]). But only efficient banks can play due roles as financial intermediary. The mal-functioning commercial banks do not only fail to provide dividends among shareholders; they also pose serious threat to the entire financial stability in a country. In Bangladesh, the commercial banks play significant roles as major sources of financing economic activities in private sectors. As Bangladeshi banking sector is the main source of financing economic activities in the private sectors and capital market is underdeveloped, proper evaluation of bank performance through sophisticated methods bears immense significance in accelerating saving-investment process towards inclusive growth, smoothing monetary transmission mechanisms and enhancing financial stability. Highlighting the importance of evaluating bank performance, Berger and Humphrey [4] rightly opines that the information obtained from bank performance evaluation can be used in formulating policy and improving managerial performance by identifying "best practices" banks and "worst practices" banks associated with high and low measured efficiency.

Banking sector in Bangladesh has shown significant progress in terms of financial deepening, growth in assets, number of bank, expansion of branches and number of account holders. Now the key indicator of financial development, the ratio of broad money (M2) to GDP stood 52 in FY15 which was 30 in 1990, 32 in 2000, 45 in 2010 and 52 in 2015. The banking sector comprise 56 banks with assets of BDT 9693.8 billion (68% of GDP), 9131 branches (56.8% rural branches) and account holders of 74.56 million in FY15 (Bangladesh Bank, [5] and Bangladesh Bank, [6]). Out of 56 commercial banks, 8 private commercial banks (PCBs) have been functioning as full-fledged Islamic Banks (Bangladesh Bank, [6]). In addition, 19 Islamic banking branches of 8 conventional banks and 25 windows of 7 conventional banks are also offering Islamic banking services (Bangladesh Bank, [7]).

Despite robust progress, the banking sector faces some key problems such as such as higher lending rate, growing amount of non-performing loan, higher interest spread, and concentration of loan in trading sector and lower investment in socially desirable sectors such as agriculture, poverty alleviation, education and health. A proper performance assessment of commercial banks would help to play their due roles to improve the performance of the commercial banks in Bangladesh. Though there are many performance studies on banking conducted in developed, emerging and developing countries, there are only few studies on the issue in Bangladesh. Given this, the present study would empirically investigate the performance of Bangladeshi commercial banks from viewpoints of technical and scale efficiency by using non-parametric Data Envelopment Analysis (DEA) during 2009-2014. It would also compare the performances among different types of commercial banks in Bangladesh.

The objectives of the paper are two-fold: firstly, examining efficiency performance of commercial banks in Bangladesh over the period from 2009 to 2014 and secondly, to

provide policy inputs for improving performance of banks in Bangladesh. More specific objectives of the paper include:

i. to investigate efficiency of commercial banks in Bangladesh during the period of 2009-2014;
ii. to compare efficiency performance among different types of commercial banks in Bangladesh during the period under review;
iii. to derive policy inputs for improvement in efficiency performance of commercial banks aiming at reaping fuller potentials of the banking industry in Bangladesh.

The remaining portion of the paper has been organized as follows: Following introduction, the second section deals with review of literature; the third section focuses on methodology; the fourth section analyses findings and policy implications; finally, the fifth section concludes and contains directions for future research.

2 Literature Review

This section shed lights on concepts of bank performance and some empirical studies on banking firms related to different countries including Bangladesh.

2.1 Performance of bank

Simply, performance of a bank means how efficiently a bank offer financial services at acceptance level of risks. Rose, P., and Hudgins, S. [8] opines 'Performance refers to how adequately a financial firm meets the needs of its stock holders (owners), employees, depositors and other creditors and borrowing customers'. In modern era, the term 'performance of bank' has been made synonymous with 'efficiency of bank' particularly since early 1980s. The 'efficiency' concept of firm derived from production function in microeconomics has been widely applied in evaluating bank performance in many quality studies/papers (Berger and Humphrey [4]). Following this tradition, Hassan, K., and Lewis, M. [9] define bank efficiency as the relative performance of a bank given its inputs or outputs compared to other banks with the same input or output limitations. In its basic output context, 'efficiency' measures the given output from a firm using a given input of resources. More efficient firms will produce more output from a given set of inputs. The most efficient bank will score 1 (or 100 per cent) while the most inefficient bank will score zero (0 percent).

Farrell ([10]) laid down the foundation of modern efficiency measurement based on the work of Debreu [11] and Koopmans [12] to define a simple measure of firm efficiency which could account for multiple inputs. He postulated that efficiency of a firm consists of two components, technical efficiency (TE) and allocative efficiency (AE). The technical efficiency (TE) expresses the ability of a firm to attain maximum outputs provided that minimum inputs are used. The allocative efficiency of a firm refers to the ability of a firm to use inputs in optimal proposition subject to available input prices. Alsarhan A, [13] opines that firm will be technically efficient if it either minimises its inputs given its output or maximises its output given its inputs. A bank is considered to be technically efficient, when it can produce the multiple outputs from available inputs operating its activities on the production frontier.

The technical efficiency can be decomposed into pure technical efficiency (PTE) and scale efficiency (SE). Al-Attafi, M. A. M., [14] defines the pure technical efficiency as the firm's ability to avoid waste by producing as much output as input usage allows, or by using as little input as output production allows. Hassan, K., and Lewis, M. [9] measure scale efficiency as the firm's ability to work at its optimal scale. The scale efficiency is defined by the ratio of a constant return to scale (CRS) score to a variable return to scale (VRS) score, i.e., TE^{CRS}/PTE^{VRS}. If the ratio is equal to 1, i.e., TE/PTE = 1, then a firm is scale efficient; otherwise, if the ratio is less than 1, or greater than 1, inefficiency arise.

2.2 Empirical Studies

There are growing number of studies relating to performance of commercial banks conducted in developed, emerging and developing countries in the world. However, there are only few papers available in Bangladesh focusing on performance of commercial banks in Bangladesh by applying modern frontier approach like Data Envelopment Analysis (DEA) and Stochastic Frontier Approach (SFA).

Berger and Humphrey [4] may be considered as the first seminal work on performance of financial institutions that made an excellent overview of 130 studies relating to performance on different financial institutions based on frontier efficiency analysis. They have outlined the results of studies on financial institution efficiency covering 21 countries that apply five different frontier approaches. Out of 130 studies, 66 studies were related to USA exclusively; the remaining studies covered other developed countries and only three developing countries namely KSA, Turkey and Tunisia. The authors summarized and critically reviewed empirical estimates of financial institution efficiency and attempted to arrive at a consensus view. The efficiency estimates from nonparametric studies were similar to those from parametric frontier models but the nonparametric methods generally yielded slightly lower mean efficiency estimates and seem to have greater dispersion than the results of the parametric models. Overall, depository financial institutions in the studies experienced an average efficiency of around 77% (median 82%).

Casu and Girardone [15] analyses the cost efficiency, profit efficiency and productivity change of Italian financial conglomerates during the 1990s utilising Stochastic Frontier Approach (SFA), and Data Envelopment Analysis (DEA) methods. The authors find reasonably similarity in magnitude in efficiency measures generated from stochastic and deterministic frontiers and also similar variation in efficiency levels. They reveal that despite similarities in range and variance of the efficiency score, the DEA cost efficiency shows increasing trend between1996 and 1998 and demonstrates a rather sharp decrease in 1999.

Drake L. and Hall M. J.B [16] analyses technical and scale efficiency of 149 Japanese banks in 1997 using data envelopment analysis (DEA). They find powerful size-efficiency relationships with respect to both technical and scale efficiency. The results also question the rationale of the large-scale merger wave in Japan as the larger (City) banks are generally found to be operating above the minimum efficient scale with limited opportunity to gain from eliminating X-inefficiencies. On the contrary, the smaller banks show higher technical efficiency. Finally, the results suggest for controlling the problem loans as its impacts have produced marked changes in both the scale and technical efficiency results.

Fiorentino E., Karmann A. and Koetter, M. [17] examines the consistency of efficiency scores of German banks employing two competing frontier methods namely Stochastic Frontier Approach (SFA) and Data Envelopment Analysis (DEA). They find that non-parametric methods were particularly sensitive to measurement error and outliers. The results also exhibit that accounting for systematic differences among commercial, cooperative and savings banks are important to avoid misinterpretation about the status of efficiency of the total banking sector. The paper also find that efficiency rank stability is very high in the short run but annually estimated efficiency scores are markedly less stable over a period of twelve years, in particular for parametric methods.

Sufian F. and Majid M. A [18] investigate the long-term trend in efficiency change of commercial banks in Singapore during the period of 1993-2003 using Data Envelopment Analysis (DEA). The paper finds that commercial banks have achieved an average overall efficiency of 95.4% in Singapore and small commercial banks have outperformed their large and very large counterparts. Using panel regression analysis, the authors also establish statistical link between cost efficiency and share price performance. The results show that the changes in stock prices tend to reflect cost efficiency albeit with small degree of reaction and stocks of cost efficient banks to some extend outperform cost inefficient banks.

Gupta, O. K., Doshit, Y., & Chinubhai, A. [19] examine productive efficiency performance of the Indian banks during the period 1999-2003 using the DEA approach and TOBIT analysis. The results of study reveal that public sector banks have the highest efficiency followed by private banks, and the other nationalized banks. The study also finds that the capital adequacy ratio has a positive and significant effect on the productive efficiency of Indian banks. Using same method, Staub, R. B., e Souza, G. D. S., & Tabak, B. M. [20] examine cost, technical and allocative efficiencies for Brazilian banks during the period of 2000-2007. The results find that Brazilian banks experience low levels of economic (cost) efficiency compared to banks in Europe and in the US.

Sok-Gee, C. [21] investigate the technical efficiency of commercial banks in China during the period 2001-2007 by employing data envelopment analysis (DEA). The author has decomposed technical efficiency into pure technical and scale efficiency to identify the sources of inefficiency of the commercial banks in China. The findings reveal that commercial banks in China on average are relatively technically inefficient and it might be due to the underdeveloped banking system in China, and its legal and financial systems are not well-developed.

Although we find a plethora of studies on bank performance across the globe, only a few studies are available for investigating bank performance in Bangladesh based on modern methods like Data Envelopment Analysis (DEA) and stochastic frontier analysis (SFA).

Rahman, M. [22] empirically investigates the efficiency of Islamic and conventional banks in Bangladesh by using different frontier approaches (DEA and SFA) over the period of 2003 to 2008. The findings reveal that conventional and Islamic banks have been improving and converge to the highest level of efficiency. The study also shows that conventional banks are only slightly more efficient than Islamic banks. However, Islami Bank Bangladesh Limited (IBBL) alone is slightly more efficient than conventional banks. The author suggests for paying serious attention to remove the shortage in human resource with short term and long term strategies.

Bhuia, M. R., Baten, A., Kamil, A. A., & Deb, N. [23] examine the relative efficiency of 20 Bangladeshi online banks during 2001–2007 by utilizing Data Envelopment Analysis (DEA). The source of technical inefficiency of the sampled banks was mainly due to scale inefficiency rather than pure technical inefficiency.

Islam, S., and Kassim, S. [24] apply data envelopment analysis (DEA) in order to compare the efficiency between Islamic and conventional banks in Bangladesh during 2009-2013. The empirical results show that average technical efficiency score of Islamic banks and conventional bank is 0.965 and 0.976 respectively. Regarding sources of inefficiency of Islamic banks, the findings reveal that scale inefficiency is the main source of technical inefficiency rather than pure technical inefficiency. In contrast, technical inefficiency of conventional banks is mainly due to pure technical inefficiency rather their scale inefficiency.

3 Methodology

The major methods used in key studies on bank performance can be grouped into two classes: financial ratios analysis approach (FAR) and frontier analysis approach**.** Under financial ratio analysis approach, different financial ratios are used to examine various aspects of banks performance. Yue [24] mentions that though the financial ratio analysis (FRA) approach is popular for its simplicity, easy understanding and user friendliness, it suffers from some limitations. Simple financial ratios cannot be reduced to a single measure that can cover the multi-faceted bank operations. As banks use multiple inputs and produce multiple outputs, this method becomes insufficient. On the other hand, efficiency performance of bank under frontier analysis approach is measured relative to a "best-practice" frontier. Berger and Humphrey, [4] opine that the frontier analysis provides an overall, objectively determined, numerical efficiency value and ranking of firms. Cummins and Weiss, [25] argue that the approach can control differences among firms in a sophisticated multidimensional framework that has its roots in economic theory. The frontier analysis approach has two methods to measure efficiency of bank: parametric (econometric) and non-parametric (linear programming-based) methods. Aigner et al., [26] and Meusen and Van Den Broeck, [27] developed the stochastic frontier analysis (SFA) as the most popular tool among parametric (econometric) methods. Charnes et al. [28] proposed data envelopment analysis (DEA) and it is the most widely used techniques among non-parametric (linear programming-based) methods in measuring efficiency of banks.

The present paper employs data envelopment analysis (DEA) in measuring technical and scale efficiency of commercial banks in Bangladesh due to its applicability with small sample size and limitations of financial ratios analysis approach (FAR) and the stochastic frontier analysis (SFA). In addition, DEA has an advantage of computing efficiency scores in multiple-inputs and multiple-outputs production setting without specifying any functional form and distribution of the inefficiency term as required by the stochastic frontier analysis (SFA).

3.1 Data Envelopment Analysis (DEA) Method: Model Specification

The data envelopment analysis (DEA) approach developed by Charnes et al. [28] is a mathematical programming based technique for assessing the performance of a set of homogeneous entities called decision making units (DMUs) which convert multiple inputs into multiple outputs. Dong, Y., [29] mentions that DEA forms an empirical production frontier or envelopment surface and measures and calculates efficiency relative to the constructed frontier. DEA is a methodology based on the production frontiers instead of the central tendencies. There are two classical DEA models namely Charnes–Cooper–Rhodes (CCR) model based on constant return to scale (CRS) developed by Charnes et al. [28] and Banker–Charnes–Cooper (BCC) model based on variable return to scale proposed by Banker et al. [30]. The present paper uses input-oriented Charnes–Cooper–Rhodes (CCR) model and Banker–Charnes–Cooper (BCC) model.

CCR Model: Under CRS assumption, the CCR model measures the overall technical efficiency of decision making units (DMUs) by computing efficiency for each DMU obtained as a maximum of a ratio of weighted outputs to weighted inputs such as $u'y_i/v'x_i$. Coelli [31] mentions that the ratio for every DMU has to be less than or equal to one. Formally the efficiency for each DMU can be obtained by the following mathematical programming approach:

$$\begin{aligned} &\text{Max}_{u,v}\ (u'y_i/v'x_i) \\ &\text{s.t. } u'y_j/v'x_j \le 1,\ j= 1,2,\ldots\ldots\ldots\ldots,N, \\ &u, v \ge 0 \end{aligned} \tag{1}$$

The equation (1) aims to find the value of u and v such that the efficiency measure of the i-th DMU is maximized subject to the constraint that all efficiency measures must be less than or equal to one. As the ratio formulation in equation (1) has a problem of an infinite number of solutions, Charnes et al. [28] impose $v'x_i=1$ to solve the problem which transforms the above problem into an equivalent linear programming problem as mentioned below.

$$\begin{aligned} &\text{Max}_{\mu,v}\ (\mu' y_i) \\ &\text{st } v'x_i = 1 \\ &u' y_j - v' x_j \le 0,\ \ j = 1,2,\ldots\ldots\ldots\ldots N \\ &\mu, v \ge 0 \end{aligned} \tag{2}$$

The notation change from (u, v) to (μ, ν) reflects the transformation which is known as the multiplier form of the DEA linear programming problem. As the concept of duality exists in linear programming, the dual for DMU_o can be derived as:

$$\begin{aligned} &\min_{\theta\lambda}\ \theta \\ &\text{st} \qquad -y_0 + Y\lambda \ge 0 \end{aligned}$$

$$\theta x_0 - X\lambda \geq 0$$

$$\lambda \geq 0 \ , \ j = 1,2, \ldots\ldots n \qquad (3)$$

The form mentioned in equation (3) is referred to as the envelopment form of DEA where θ is a scalar, λ is a N*1 vector of constant, y_o is an output vector for DMUo, Y is the matrix of outputs of the other DMUs and x_o is the vector of input of DMU_o and X is the matrix of input of the other DMUs. The value of θ obtained will be the efficiency score for a particular DMU where $0 \leq \theta \leq 1$. In case θ has value equal to 1 the DMU lies on the frontier and is fully efficient while when $\theta < 1$, DMU is a relatively inefficient one.

BCC Model: The constant return to scale (CRS) assumption of CCR model is inappropriate as all DMUs cannot operate at an optimum scale due to imperfect market condition and other constraints. The use of CRS in case of DMUs not operating at an optimum scale results in measures of TE confounded by SE. Given this, it is therefore reasonable to adopt variable return to scale (VRS), which ensures that a firm is compared only with firms of a similar size. The VRS programming can be obtained by adding a constraint $N1\lambda = 1$ to the CCR problem (Eq. 1).

$$\min_{\theta\lambda} \ \theta$$

$$\text{st} \qquad -y_0 + Y\lambda \geq 0$$

$$\theta x_0 - X\lambda \geq 0$$

$$N1'\lambda = 1$$

$$\lambda \geq 0 \qquad (4)$$

where N1 is a N*1 is vector of ones. The model with VRS creates the frontier as a convex hull of intersecting planes in contrast to the model with CRS, which forms a conical hull. The VRS model thus envelops the data more tightly and provides efficiency scores that are equal or greater than those of the CRS.

3.2 Specification of Input and Output variables

In order to employ DEA approach, it is essential to define relevant input and output variables when measuring the efficiency of banks (Berger and Mester [32]). Major bank studies use either production or intermediate approach. Our paper adopts the intermediation approach to select variables that has widely been used in bank studies (Hassan, M.K., 2006 [33] and Islam, S., & Kassim, S., [24]). The intermediation approach is suitable for banking study as banks intermediate between savers and investors by transforming deposits into earning assets, rather than as producers of services and loans. We select three inputs and three outputs for the model.

The input vectors include (a) deposits, (b) fixed assets and (c) labor. We measure deposits by the sum of demand and time deposits, fixed assets by costs on premises and fixed assets and labor by staff costs. On the other hand, the output vector includes (a) total loans; (b) other earning assets (funds used in corporate and Government securities) and (c) off- balance sheet activities (Acceptances and endorsements, Letters of guarantee,

Irrevocable letters of credit, Bills for collection). All variables are measured in millions of BDT (Bangladesh currency Unit, Taka).

3.3 Sample Size

Our empirical analysis is based on a sample of 19 commercial banks out of 56 commercial banks (June 2015) in Bangladesh which includes 4 state-owned commercial banks, 10 domestic private conventional commercial banks and 5 Islamic commercial banks. The four state-owned banks cover 91% assets among state-owned banks, 10 domestic private banks cover 54% assets among private banks and 5 Islamic commercial banks cover 84% assets among Islamic banks. The 19 banks in the sample cover over 65% assets of the entire banking industry in Bangladesh which is well representative of the banking industry in Bangladesh. List of sample banks is shown in Appendix 1.

3.4 Data

The study uses balanced panel data of selected banks collected from their annual reports during 2009-2014 for measuring and comparing technical and scale efficiency performance of commercial banks in Bangladesh. The DEAP version 2.1 program developed by Coelli, T. [31] is used to compute efficiency applying data envelopment analysis.

4 Results and Findings

The present section analyses efficiency scores of each commercial bank in the sample on an annual basis during 2009- 2014. In addition, this section also investigates scale of production in order to determine whether a bank is operating at optimum level under constant returns-to-scale (CRS) or below optimum level under increasing returns-to-scale (IRS) or above optimum level under decreasing returns-to-scale (DRS). Increasing returns-to-scale (IRS) implies that a bank can gain efficiency by increasing its production level while decreasing returns-to-scale (DRS) implies that a reduction in scale increases efficiency. Constant returns-to-scale indicates that there is no efficiency gain by changing the scale of production.

4.1 Efficiency of State Owned Commercial Banks (SCBs)

4.1.1Technical, Pure Technical and Scale Efficiency

During the study period (2009 to 2014), no state owned commercial bank (SCBs) achieves 100% efficiency attaining score 1 (one) as shown in table 1. Janata Bank among all state owned commercial banks (SCBs) in the sample secures highest efficiency score in three categories of efficiency- technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE). The mean scores of Janata Bank in TE, PTE and SE are 0.9230, 1.00 and 0.9230 meaning that Janata Bank experiences 7.62 percent inefficiency in technical efficiency (TE) and scale efficiency (SE) and 100 percent efficiency in pure technical efficiency (PTE).

Rupali Bank attains second highest efficiency score in two categories of efficiency-technical efficiency (TE) and scale efficiency (SE). The mean scores of Rupali Bank in TE, PTE and SE are 0.9185, 0.9712 and 0.9460 meaning that Rupali Bank experiences 8.15

percent inefficiency in technical efficiency (TE), 2.88 percent inefficiency in pure technical efficiency (PTE) and 5.40 percent inefficiency in scale efficiency (SE).

Agrani Bank secures third highest efficiency score in two categories of efficiency-technical efficiency (TE) and scale efficiency (SE). The mean scores of Agrani Bank in TE, PTE and SE are 0.8653, 0.9905 and 0.8732 meaning that Agrani Bank Bank incurs 13.47 percent inefficiency in technical efficiency (TE), 0.95 percent inefficiency in pure technical efficiency (PTE) and 12.68 percent inefficiency in scale efficiency (SE).

Sonali Bank, the largest Bangladeshi commercial bank ranks fourth and attains least efficiency scores in technical efficiency (TE) and scale efficiency (SE) which are same (0.7290). This means that Sonali incurs 27.10 percent inefficiency in both technical efficiency (TE) and scale efficiency (SE). However, it secures score 1 in pure technical efficiency (PTE).

Table 1: Efficiency Scores of State Owned Commercial Banks (SCBs)

SCB	Efficiency	2009	2010	2011	2012	2013	2014	Mean Scores	Inefficiency (%)
Sonali	TE	0.9480	0.6050	0.8070	0.7990	0.6340	0.5810	0.7290	27.10
	PTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
	SE	0.9480	0.6050	0.8070	0.7990	0.6340	0.5810	0.7290	27.10
Janata	TE	1.0000	0.7900	1.0000	0.8750	1.0000	0.8780	0.9238	7.62
	PTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
	SE	1.0000	0.7900	1.0000	0.8750	1.0000	0.8780	0.9238	7.62
Agrani	TE	0.9790	0.7870	1.0000	0.9660	0.7280	0.7320	0.8653	13.47
	PTE	1.0000	0.9430	1.0000	1.0000	1.0000	1.0000	0.9905	0.95
	SE	0.9790	0.8340	1.0000	0.9660	0.7280	0.7320	0.8732	12.68
Rupali	TE	1.0000	1.0000	0.9960	0.7890	0.7260	1.0000	0.9185	8.15
	PTE	1.0000	1.0000	1.0000	0.8270	1.0000	1.0000	0.9712	2.88
	SE	1.0000	1.0000	0.9960	0.9540	0.7260	1.0000	0.9460	5.40

Source: Authors' calculation based on data envelopment analysis.

4.1.2 Returns to Scale (RTS) of State Owned Commercial Banks (SCBs)

During the study period (2009 to 2014) Sonali Bank among all state owned commercial banks (SCBs) in the sample shows decreasing returns-to-scale (DRS) in every year (Table -2). This means that Sonali Bank could have increased efficiency by reducing its scale of production. Janata Bank shows decreasing returns-to-scale (DRS) in three years (2010, 2012, 2014) meaning that this bank could have increased efficiency by reducing scale during this period. Janata Bank exhibits the optimum or most productive scale of operation under CRS in 2009, 2011 and 2013. Agrani Bank exhibits decreasing returns-to-scale (DRS) in five years (2009, 2010, 2012, 2013, 2014) meaning that this bank could have increased efficiency by reducing scale during this period. Agrani Bank exhibits the optimum scale of operation under CRS in 2009. Rupali Bank demonstrates decreasing returns-to-scale (DRS) in two years (2011, 2014), increasing returns-to-scale (IRS) in two years (2012, 2013) and CRS in two years (2009, 2010).

Table 2: RTS of State Owned Commercial Banks (SCBs)

SCB	2009	2010	2011	2012	2013	2014
Sonali	drs	drs	drs	drs	drs	drs
Janata	crs	drs	crs	drs	crs	drs
Agrani	drs	drs	crs	drs	drs	drs
Rupali	crs	crs	drs	irs	irs	drs

Source: Authors' calculation based on data envelopment analysis.

4.2.1 Efficiency of Conventional Private Commercial Banks (CPCBs)

During the study period, Southeast Bank is the only bank which is fully efficient bank among all 10 conventional private commercial banks in the sample (Table 3) attaining score 1 (one) in technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE). The efficiency score of one in three categories of efficiency indicate that Southeast Bank attain 100% technical efficiency.

Both AB Bank and Prime Bank secure second positions in technical efficiency among the sample bank. These two banks attain technical efficiency scores of 0.9862 and 0.9820 (mean) respectively meaning that they face 1.38 percent and 1.80 percent inefficiency only. The mean scores of pure technical efficiency and scale efficiency of the two banks are 0.9873, 0.9988 and 0.9897, 0.9923 respectively. This means that technical inefficiencies of the two banks (1.38 and 1.80) are attributed mainly to pure technical inefficiencies (1.27% and 1.03%) rather scale inefficiencies (0.12% and 0.77%).

Table 3: Efficiency of Conventional Private Commercial Banks (CPCBs)

CPCBs	Efficiency	2009	2010	2011	2012	2013	2014	Mean	Inefficiency (%)
Pubali	TE	0.9510	0.8370	0.9110	0.9080	0.9170	0.9510	0.9125	8.75
	PTE	0.9540	0.8400	0.8170	0.9090	0.9180	1.0000	0.9063	9.37
	SE	0.9880	0.9960	0.9110	0.9990	0.9980	0.9510	0.9738	2.62
AB	TE	1.0000	0.9970	0.9670	0.9530	1.0000	1.0000	0.9862	1.38
	PTE	1.0000	1.0000	0.9700	0.9540	1.0000	1.0000	0.9873	1.27
	SE	1.0000	0.9970	0.9970	0.9990	1.0000	1.0000	0.9988	0.12
NBL	TE	1.0000	0.8980	1.0000	0.9400	1.0000	1.0000	0.9730	2.70
	PTE	1.0000	0.9030	1.0000	0.9590	1.0000	1.0000	0.9770	2.30
	SE	1.0000	0.9950	1.0000	0.9800	1.0000	1.0000	0.9958	0.42
City	TE	0.8200	1.0000	1.0000	0.9780	0.9780	0.8210	0.9328	6.72
	PTE	0.8990	1.0000	1.0000	1.0000	1.0000	0.8890	0.9647	3.53
	SE	0.9140	1.0000	1.0000	0.9780	0.9780	0.9140	0.9640	3.60
IFIC	TE	1.0000	0.8500	0.9620	0.9350	0.9080	1.0000	0.9425	5.75
	PTE	1.0000	0.9220	1.0000	1.0000	1.0000	1.0000	0.9870	1.30
	SE	1.0000	0.9220	0.9620	0.9350	0.9080	1.0000	0.9545	4.55
UCBL	TE	0.8920	0.8250	0.8930	0.8480	0.9190	0.8920	0.8782	12.18
	PTE	0.8930	0.8290	0.9070	0.7860	0.9260	0.8930	0.8723	12.77
	SE	0.9990	0.9950	0.9850	0.9770	0.9960	0.9990	0.9918	0.82

DBBL	TE	0.8140	0.79900	0.8220	1.0000	0.7850	0.8140	0.8390	16.10
	PTE	0.8570	0.80200	0.8290	1.0000	0.7950	0.8570	0.8567	14.33
	SE	0.9500	0.99700	0.9910	1.0000	0.9880	0.9500	0.9793	2.07
Prime	TE	1.0000	1.0000	0.9750	0.9970	0.9200	1.0000	0.9820	1.80
	PTE	1.0000	1.0000	1.0000	1.0000	0.9380	1.0000	0.9897	1.03
	SE	1.0000	1.0000	0.9750	0.9970	0.9820	1.0000	0.9923	0.77
Southeast	TE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
	PTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
	SE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
Brac	TE	0.9660	0.9720	0.9840	0.9460	1.0000	0.9660	0.9723	2.77
	PTE	0.9690	0.9750	0.9870	0.9470	1.0000	0.9690	0.9745	2.55
	SE	0.9970	0.9970	0.9960	0.9990	1.0000	0.9970	0.9977	0.23

Source: Authors' calculation based on data envelopment analysis.

Both NBL and Brac Bank achieve third positions in technical efficiency among the sample bank. These two banks attain technical efficiency scores of 0.9730 and 0.9723 (mean) respectively indicating that they experience 2.70 percent and 2.77 percent inefficiency. The mean scores of pure technical efficiency and scale efficiency of the two banks are 0.9770, 0.9958 and 0.9745 and 0.9977 respectively. This means that technical inefficiencies of the two banks (2.70 and 2.77) are attributed mainly to pure technical inefficiencies (2.30% and 2.55%) rather scale inefficiencies (0.42% and 0.23%).

IFIC Bank ranks fourth with a score of 0.9425 in technical efficiency (TE), a score of 0.9870 in pure technical efficiency (PTE) and a score of 0.9547 in scale efficiency (SE). IFIC Bank incurs inefficiency of 5.75% in technical efficiency (TE), 1.30% in pure technical efficiency (TE) and 4.55% in scale efficiency indicating that the key reason behind technical inefficiency of 5.75% is scale inefficiency of 4.55% rather than pure technical inefficiency of 1.30%.

The fifth ranked bank among conventional private banks in the sample is City Bank that secures a score of 0.9328 in technical efficiency (TE), a score of 0.9647 in pure technical efficiency and a score of 0.9640 in scale efficiency (SE). The inefficiency in technical efficiency (TE) faced by City Bank is 6.72% in which pure technical inefficiency (3.53%) and scale inefficiency (3.60%) contribute equally. Pubali bank stands sixth in efficiency attaining a score of 0.9125 in technical efficiency (TE), a score of 0.9063 in pure technical efficiency and a score of 0.9738 in scale efficiency (SE). Pubali Bank faces technical inefficiency mainly due to pure technical inefficiency (9.37%) rather scale inefficiency (2.62%).

UCBL ranks 7th and Duct-Bangla Bank ranks 8th attaining scores of 0.8782 and 0.8390 in technical efficiency, scores of 0.8723 and 0.8567 in pure technical efficiency and score of 0.9918 and 0.9793 in scale efficiency (SE). These banks face inefficiency of 12.18 percent and 16.10 percent following higher inefficiency in pure technical inefficiency (12.77% and 14.33%) rather scale inefficiency (0.82% and 2.07%).

4.2.2 Returns to Scale (RTS) of Conventional Private Commercial Banks (CPCBs)

During the study period (2009 to 2014) only Southeast Bank among all conventional private commercial banks in the sample shows constant returns-to-scale (CRS) in every year (Table-4). This means that Southeast Bank exhibits the optimum or most productive scale of operation during the whole study period and this bank does not need to change its scale of production. NBL experiences constant returns-to-scale (CRS) in four years (2009, 2011, 2013, 2014) and decreasing returns-to-scale (DRS) in two years (2010, 2012). NBL could reduce production scale for enhancing efficiency in 2010 and 2012.

Table 4: RTS of Conventional Private Commercial Banks (CPCBs)

PCCBs	2009	2010	2011	2012	2013	2014
Pubali	drs	irs	drs	drs	drs	irs
AB	crs	drs	drs	drs	crs	crs
NBL	crs	drs	crs	drs	crs	crs
City	irs	crs	crs	irs	irs	crs
IFIC	crs	irs	irs	irs	irs	irs
UCBL	drs	drs	drs	drs	drs	crs
DBBL	irs	irs	irs	crs	irs	irs
Prime	crs	crs	drs	drs	drs	irs
Southeast	crs	crs	crs	crs	crs	crs
Brac	drs	drs	drs	drs	crs	irs

AB Bank shows constant returns-to-scale (CRS) in three years (2009, 2013, 2014) and decreasing returns-to-scale (DRS) in three years (2010, 2011, 2012). This means that NBL could reduce production scale for enhancing efficiency in 2010, 2011 and 2012. City Bank also demonstrates decreasing CRS in three years (2010, 2011 and 2014) but IRS in three years (2009, 2012 and 2013). City Bank could increase production scale in 2009, 2012 and 2013 for promoting efficiency. Prime Bank shows CRS in two years (2009, 2010), DRS in three years (2011, 2012, and 2013) and IRS in one year (2014). Prime Bank could decrease production scale in 2009, 2012 and 2013, and increase the same in 2014 for promoting efficiency. While Brac Bank exhibits the optimum scale of operation under CRS in 2013, it shows DRS in 2009, 2010, 2011 and 2012, and IRS in 2014. Brac Bank could decrease production scale in 2009, 2010, 2011 and 2012, and increase the same in 2014 for promoting efficiency.

IFIC Bank and DBBL show the optimum or most productive scale of operation under CRS in 2009 and 2012 respectively. The two bank exhibits IRS in five years (2010, 2011, 2012, 2013, 2014) and (2009, 2010, 2011, 2013, 2014) respectively meaning that these banks could increase efficiency during this period by raising production scale. UCBL exhibits the optimum scale of operation under CRS in 2014 but shows DRS in 2009, 2010, 2011, 2012 and 2013. Though UCB did not need to change production scale in 2014, it could increase efficiency during remaining period by reducing production scale. Pubali Bank could not show the optimum or most productive scale of operation under CRS in any

year; it exhibits IRS in two years (2010, 2014) and DRS in four years (2009, 2011, 2012, and 2013). This means that Pubali could decrease production scale in 2009, 2011, 2012, and 2013, and increase the same in 2010 and 2014 for promoting efficiency.

4.3.1 Efficiency of Islamic Private Commercial Banks (IPCBs)

Table-5 depicts technical efficiency (TE), pure technical efficiency and scale efficiency (SE) of Islamic commercial banks. Among Islamic banks in the sample, EXIM is fully efficient bank with mean score of 1 (one) in three categories of efficiency- technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE).

Table 5: Efficiency of Islamic Private Commercial Banks (IPCBs)

ICB	Efficiency	2009	2010	2011	2012	2013	2014	Mean	Inefficiency (%)
IBBL	TE	0.9370	0.8920	0.9260	0.9260	0.9210	0.9170	0.9198	8.02
	PTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
	SE	0.9370	0.8920	0.9260	0.9260	0.9210	0.9170	0.9198	8.02
AIBL	TE	1.0000	0.9890	1.0000	0.9660	1.0000	1.0000	0.9925	0.75
	PTE	1.0000	0.9420	1.0000	0.9690	1.0000	1.0000	0.9852	1.48
	SE	1.0000	0.9890	1.0000	0.9970	1.0000	1.0000	0.9977	0.23
SIBL	TE	0.9010	0.8200	0.8400	0.8600	0.9420	0.9660	0.8882	11.18
	PTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
	SE	0.9010	0.8200	0.8400	0.8600	0.9420	0.9660	0.8882	11.18
EXIM	TE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
	PTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
	SE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
SJIBL	TE	0.9480	0.9760	1.0000	1.0000	1.0000	0.9480	0.9787	2.13
	PTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.00
	SE	0.9480	0.9760	1.0000	1.0000	1.0000	0.9480	0.9787	2.13

Source: Authors' calculation based on data envelopment analysis

The second highest efficient bank among Islamic banks in the sample is Al Arafah Islami bank that secures mean score of 0.9925 in technical efficiency (TE), a score of 0.9852 in pure technical efficiency and a score of 0.9977 in scale efficiency (SE). This Islamic Bank experiences marginal inefficiency in three categories of efficiency which are 0.75 percent in technical efficiency (TE), 1.48 percent in pure technical efficiency (PTE) and 0.23 percent inefficiency in scale efficiency (SE). Shahjalal Islami Bank ranks third among Islamic banks in the sample that secures mean score of 0.9787 in technical efficiency (TE), a score of 1.0000 in pure technical efficiency and a score of 0.9787 in scale efficiency (SE). This Islamic bank faces marginal inefficiency (2.13%) in both technical efficiency (TE) and in scale efficiency (SE) but it secures 100.00 efficiency in pure technical efficiency (PTE).

Islami Bank Bangladesh Limited, the largest Islamic bank and the second largest bank in the entire banking sector in Bangladesh ranks fourth among Islamic banks with a score of 0.9198 in technical efficiency (TE), a score of 1.0000 in pure technical efficiency and a score of 0.9198 in scale efficiency (SE). A score of 0.9198 in both technical efficiency (TE) and scale efficiency (SE) means that IBBL incur 8.02% inefficiency. The

100% efficiency in pure technical efficiency implies that 8.02% inefficiency is attributed to scale inefficiency only. Social Islami Bank ranks fifth among Islamic banks in the sample. It secures least efficiency with mean score of 0.8882 in technical efficiency (TE), a score of 1.0000 in pure technical efficiency and a score of 0.8882 in scale efficiency (SE). This Islamic bank experiences 11.18% inefficiency in both technical efficiency (TE) and scale efficiency (SE). This bank faces inefficiency due to scale inefficiency only as it secures 100% efficiency in pure technical efficiency.

4.3.2 Returns to Scale (RTS) of Islamic Private Commercial Banks (IPCBs)

During the study period (2009 to 2014), only EXIM Bank among all Islamic private commercial banks in the sample shows constant returns-to-scale (CRS) in every year (Table-6). This means that EXIM Bank exhibits the optimum or most productive scale of operation during the whole study period and this bank does not need to change its scale of production. AIBL experiences constant returns-to-scale (CRS) in four years (2009, 2011, 2013, 2014) and increasing returns-to-scale (IRS) in one year (2010) and DRS in one year (2012). AIBL could have increased production scale in 2010 and reduce the same in 2012 for enhancing efficiency. SJIBL shows constant returns-to-scale (CRS) in four years (2009, 2011, 201, 2013) and increasing returns-to-scale (IRS) in two year (2010 and 2014). SJIBL could increase production scale in 2010 and 2014 for enhancing efficiency.

Table 6: RTS of Islamic Private Commercial Banks (IPCBs)

ICB	2009	2010	2011	2012	2013	2014
IBBL	drs	drs	drs	drs	drs	drs
AIBL	crs	irs	crs	drs	crs	crs
SIBL	irs	irs	irs	irs	irs	irs
EXIM	crs	crs	crs	crs	crs	crs
SJIBL	crs	irs	crs	crs	crs	irs

Source: Authors' calculation based on data envelopment analysis

Among Islamic commercial banks in the sample, Islami Bank shows decreasing returns-to-scale (DRS) in every year meaning that it could reduce production scale for promoting efficiency. On the other hand, SIBL exhibits increasing returns-to-scale (IRS) in every year meaning that it could increase production scale for promoting efficiency.

4.4 Relative Efficiency of State-owned, Conventional Private and Islamic Banks

4.4.1 Comparative Efficiency of State-owned, Conventional Private and Islamic Banks

The comparative analysis regarding efficiency of state-owned, conventional private and Islamic banks reveals that Islamic commercial banks, on average, show higher efficiency scores in two categories of efficiency (0.9958 in technical efficiency and 0.9970 in pure technical) out of three categories of efficiency- technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE). Conventional private commercial banks exhibit higher efficiency score (0.9848) in scale efficiency (SE) compared to state-owned banks (0.8680) and Islamic banks (0.9569). State-owned commercial banks show greater efficiency score (0.9904) in pure technical efficiency

(PTE) compared to conventional private (0.9516) but they slightly exhibit lower pure technical efficiency score than Islamic banks (0.9970). A comparative position is illustrated in Table 8.

Table 7: Mean Efficiency of State-owned, Conventional Private and Islamic Banks

Bank	Efficiency	2009	2010	2011	2012	2013	2014	Mean	Inefficiency (%)
SCB	TE	0.9818	0.7955	0.9508	0.8573	0.7720	0.7978	0.8592	14.08
	PTE	1.0000	0.9858	1.0000	0.9568	1.0000	1.0000	0.9904	0.00
	SE	0.9818	0.8073	0.9508	0.8985	0.7720	0.7978	0.8680	13.20
CPCB	TE	0.9443	0.9178	0.9514	0.9505	0.9427	0.9444	0.9419	5.81
	PTE	0.9572	0.9271	0.9510	0.9555	0.9577	0.9608	0.9516	4.84
	SE	0.9848	0.9899	0.9817	0.9864	0.9850	0.9811	0.9848	1.52
ICB	TE	0.9572	0.9354	0.9532	0.9504	0.9726	0.9662	0.9558	4.42
	PTE	1.0000	0.9884	1.0000	0.9938	1.0000	1.0000	0.9970	0.00
	SE	0.9572	0.9354	0.9532	0.9566	0.9726	0.9662	0.9569	4.31

Source: Authors' calculation based on data envelopment analysis

4.4.2 Frequency of Different RTS of State-owned, Conventional Private and Islamic Banks

The comparative analysis regarding frequency of different types of returns to scale (RTS) during the study period (2009-2014) reveals that Islamic commercial banks show higher number of frequency of CRS (46.67%) than those of conventional private banks (36.67%) and state-owned commercial banks (25.00%). This means that Islamic banks use optimum or most productive production scale in 46.67% cases of RTS (Table 9). While the number of frequency of state-owned commercial banks showing DRS is 66.67 percent which are higher than those of conventional private banks (31.67%) and Islamic commercial banks (23.33%). This means that 66.67 percent state-owned commercial banks, 31.67% private commercial banks and 23.33% Islamic banks could have increased efficiency by reducing production scale. On the other hand, 31.67% private commercial banks, 30.00% Islamic commercial banks and 8.33% state-owned commercial banks exhibited IRS meaning that they could have increased efficiency by increasing production scale.

Table 8: Frequency of Different RTS of State-owned, Conventional Private and Islamic Banks (%)

Bank	Constant returns-to-scale (CRS)	Increasing returns-to-scale (IRS)	Decreasing returns-to-scale (DRS)
SCB	25.00	8.33	66.67
IPCB	36.67	31.67	31.67
ICB	46.67	30.00	23.33

4.5 Policy Implications

The findings of the paper are helpful in deriving the following policy implications:

(i) The efficiency results reveal that state-owned banks suffer technical inefficiency (14.08%) mainly due to scale inefficiency (13.20%) rather pure technical inefficiency (0.96%). This suggests that state-owned banks showing DRS need to improve their technical efficiency by either undertaking steps for diversification of products or reducing production scale. State-owned banks showing IRS need to improve their technical efficiency by increasing production scale.

(ii) The efficiency results show that conventional private banks incur technical inefficiency (5.81%) mainly due to pure technical inefficiency (4.84%) rather scale inefficiency (1.52%). The efficiency result suggest that conventional private banks need to improve their technical efficiency by improving managerial performance as underperforming management creates pure technical inefficiency.

(iii) The efficiency results exhibit that Islamic banks face technical inefficiency (4.42%) mainly due to scale inefficiency (4.31%) rather pure technical inefficiency (0.30%). The efficiency result recommends that Islamic banks need to improve their technical efficiency by improving scale efficiency. To this end, Islamic banks showing DRS undertake steps for diversification of products or reduce production scale. Islamic banks showing IRS need to improve their technical efficiency by increasing production scale.

5 Conclusions and Directions for Future Research

The paper measures and compares the performance of state-owned banks, conventional private banks and Islamic banks operating in Bangladesh during 2009-2014 using the Data Envelopment Analysis. It selects 19 commercial banks, of which four are state-owned banks, ten are conventional commercial banks and five are Islamic banks. The paper shows that the average technical efficiency scores of state-owned banks, conventional private banks and Islamic banks are 0.8592, 0.9412 and 0.9558 respectively. The efficiency results suggest that both state-owned and Islamic banks may improve their technical efficiency by undertaking steps for diversification of products. Conventional private banks may improve their technical efficiency by upgrading managerial performance. The findings of the paper should be interpreted carefully by the stakeholders. The DEA method has weakness as it does not consider error terms that can influence efficiency. Our sample is based on 19 banks out of fifty six banks for six years period only. In addition, efficiency of banks does not depend only on inputs and outputs; it is also influenced by environmental factors such as bank size, asset quality, ownership, labour productivity and macroeconomic variables namely GDP growth and inflation. Moreover, performance evaluation of Islamic Banks needs to apply additional tools beyond traditional tools as these banks have to follow the rules of Islamic Shariah. To provide a more reliable and robust finding, future research may include adoption of two methods rather than single method for methodological cross checking, choice of additional tools for performance analysis of Islamic banks, selection of larger sample size with longer period and inclusion

of environmental factors in the models selected for performance analysis of commercial banks in Bangladesh.

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Appendix 1

List of Sample Commercial Banks

A. Name of State-owned Banks	Assets (2014) (in billion BDT)	Years of operations
1. Sonali Bank Limited	934.59	46
2. Janata Bank Limited	629.45	46
3. Agrani Bank Limited	495.9	46
4. Rupali Bank Limited	268.38	46
B. Conventional Private Banks		
1. Pubali Bank Limited	248.38	46
2. AB Bank Limited	254.66	35
3. National Bank Limited	256.53	35
4. City Bank Limited	177.19	35
5. IFIC Bank Limited	156.33	35
6. United Commercial Bank Limited	272.95	35
7. Dutch-Bangla Bank Limited	215.99	23
8. Prime Bank Limited	254.91	23
9. Southeast Bank Limited	236.21	21
10. Brac Bank Limited	204.59	21
C. Islamic Banks		
1. Islamic Bank Bangladesh Limited	652.42	34
2. Al Arafah Islamic Bank Limited	206.54	23
3. Social Islami Bank Limited	153.73	23
4. EXIM Bank Limited	232.50	18
5. Shahjalal Islami Bank	126.75	18